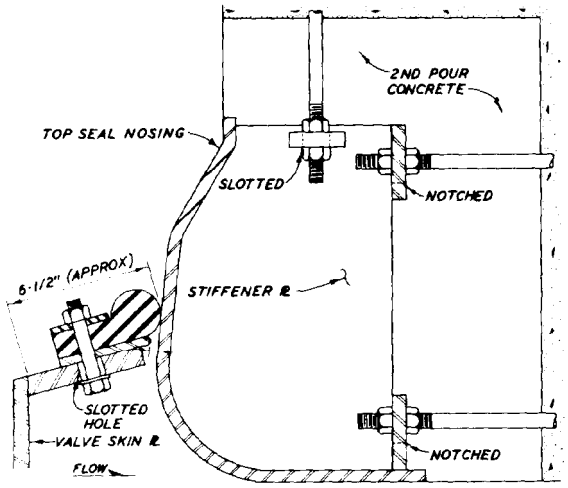
CHAPTER 4. VALVE SEALS

4-1. General. Valve seals are the responsibility, primarily, of mechanical design but the hydraulic designer should be aware of cavitation, vibration, and hoist load problems that can result from poor seals. Leaks around valves in high-lift locks can result in cavitation and possible damage to the culvert or the valve. The seals given as examples in this manual have proved satisfactory; however, other arrangements of seals have also been used successfully. It has been found that inadequate anchorage is one of the major causes of problems with embedded items. The blockouts and anchorage systems shown on the examples of seals given herein are required for proper installation.

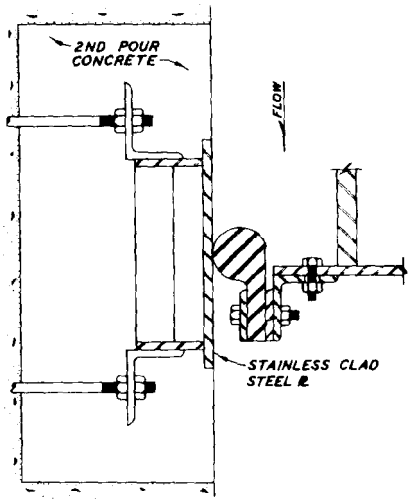
4-2. Bottom Seals. Satisfactory sealing across the bottom of a tainter valve can be accomplished by pressure contact of the lip of the valve on a metal sleeper embedded in the culvert floor (see fig. 4-1). The bottom edge of the skin plate should be ground in the field to provide a smooth and uniform contact with the sill plate. Flexible (rubber) bottom seals can be a source of serious vibrations; and since it has been demonstrated that with reasonable care good metal-to-metal contact can be obtained for the full length of the sill, use of flexible seals is not advocated. However, a compression-type rubber bottom seal has been used successfully on high-lift locks by the Walla Walla District.

4-3. Side Seals. Rubber J-type seals are recommended for the sides of the valve, figure 4-1. These seals should bear against and slide along curved stainless steel plates embedded flush with the culvert walls. Also, these plates should extend into the valve well for the full height of the opened valve in order to provide lateral support for the valve in the open position. In several installations where lateral support was not provided for the fully open valve, the jostling action of the highly turbulent flow circulating in the valve well resulted in loosening of trunnion anchorages and other damage. The side plates should be free of irregularities that might cause the rubber seal to wear or lose contact. It is very important that the rubber seals be adjusted to maintain a relatively uniform contact with the seal plates. Loss of contact, in addition to allowing leakage, can result in seal flutter which will cause serious vibrations throughout the valve.

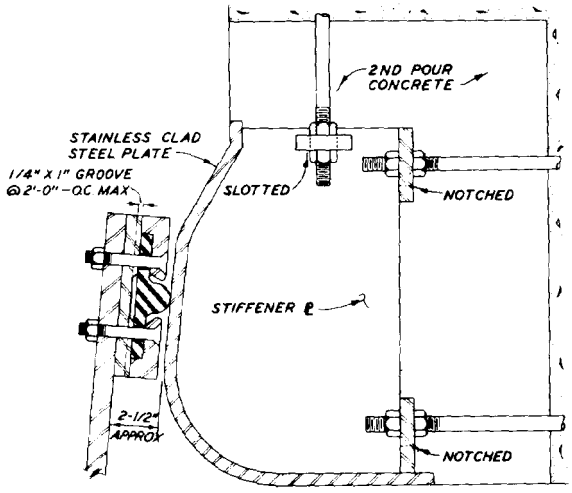
4-4. Top Seals. The seal at the top of the valve is likely to present more problems than those at the sides and bottom. The top seal must mate smoothly with the top seal plate and, at the same time, allow the bottom edge of the valve to rest with sufficient pressure on the sill to seal the valve at the bottom. A prolonged rubbing contact and slow breakaway are very undesirable as they are conducive to vibration.



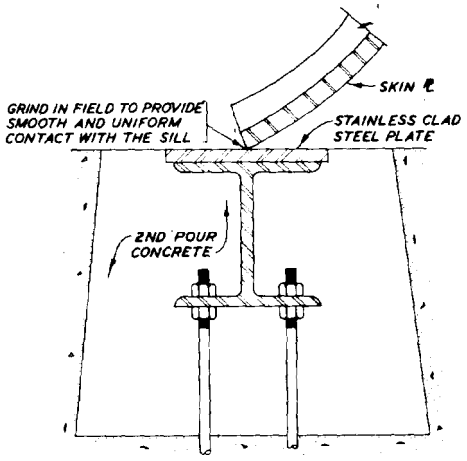
REVERSE TAINTER VALVE TOP SEAL
LOW HEAD PROJECTS



TAINTER VALVE SIDE SEALS



NORMAL AND REVERSE TAINTER VALVE
TOP SEAL HIGH AND LOW HEAD PROJECTS



TAINTER VALVE BOTTOM SEAL

NOTES: 1. PROVIDE 0.060" ABRASION RESISTANT FLUOROCARBON FILM ON RUBBER SEALS
2. SEAL RETAINER BOLTS SHOULD BE LOCKED TO PREVENT LOOSENING DUE TO VIBRATION

Figure 4-1. Valve seals

Also, the portion of the top seal including the seal bracket that extends beyond the skin plate is exposed to an unbalanced head equal to the lift. This head decreases as the seal moves away from the top seal plate and becomes zero when the distance between the top seal and any part of the gate well face exceeds the distance between the skin plate and the seal plate. In a reverse tainter valve at the beginning of the opening cycle, the hoist must overcome this unbalanced head at the same time it is "breaking" the seals and this may result in the peak load on the hoist. Obviously, it is desirable to maintain the seal projection on the valve as short as practicable.

a. Two designs for the top seal are shown in figure 4-1. One design is suitable only for reverse tainter valves in locks with relatively low lifts (about 40 ft or less). In this design, the seal bracket projects about 6 in. (horizontally) beyond the skin plate. The unbalanced load in pounds per foot of valve width with the valve closed is equal to 31.25 times the lift in feet. The other design is suitable for all lifts with the valve in either the reverse or normal position. The unbalanced load (downpull for reverse tainter valve, uplift for normal) on this seal in pounds per foot of valve width is only about 13 times the lift in feet. A J-type seal also can be used in high-lift projects, but the clearance between the skin plate and seal nose should not exceed about 2-l/2 in. and the seal bulb should be partially constrained to prevent excessive flutter as the seal is broken.

b. It is difficult to prevent leaks at the junction of the side and top seals. For projects with lifts up to about 40 ft, a molded corner that in effect makes a continuous seal is desirable. However, molded corners tend to transmit movement of the side seals to the top seals and have caused working and eventual failure of the top seals. An arrangement that allows independent movement of side and top seals is suggested at projects with lifts greater than about 40 ft.